LONGITUDE

MADE EASY,

FROM THE

MOON's ALTITUDE ONLY.

By WILLIAM GARRARD.
Author of the TRIGONOMETRICAL TABLES.

CHELSEA:
Printed for the AUTHOR, by D. JAQUES, No. 7,
Neat Houses.
M,DCC,XCI.

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PREFACE.

THE Method of finding the Longitude from the Obſerved diſtance between the Sun and Moon, or the Moon and a known Fixed Star, being attended with ſo many Difficulties in making the Obſervations, but more particularly in the Calculations for deducing the true diſtance from the obſerved, that notwithſtanding the pains which have been taken by the Conductors of the Nautical Ephemeries in preparing Tables for that purpoſe, *An eaſier and better Solution is yet a deſideratum in the Science of Navigation.*

The following Method from the Moon's Altitude, being dependant on one Obſervation only, and the Calculation performed with ſuch eaſe and expedition,

expedition, induces the Author to hope it will meet the Approbation of the Public.—The annexed Tables are sufficient for Correcting the Moon's Altitude independant of any other. The Rules are laid down in such a Plain and Practical Manner, that those of the least practice in Navigation may follow them without difficulty: and although the common Lunar Observations are now become so universally esteemed, this method will, nevertheless, be found of the utmost Service, as the Moon's Altitude alone may frequently be taken when Co-temporary Observations cannot be made.

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TABLE I.

Height of the Eye in Feet.	Dip.	
	′	″
1	0	5
2	1	21
3	1	39
4	1	55
5	2	8
6	2	20
7	2	31
8	2	42
9	2	52
10	3	1
11	3	10
12	3	18
13	3	26
14	3	34
15	3	42
16	3	49
17	3	56
18	4	3
19	4	10
20	4	16
22	4	28
24	4	40
26	4	52
28	5	3
30	5	14
32	5	23
34	5	34
36	5	43
38	5	52
40	6	2
42	6	10
44	6	18
46	6	26
48	6	34
50	6	44
55	7	3
60	7	23
65	7	41
70	7	59
75	8	16
80	8	32
85	8	48

TABLE II. OF REFRACTION.

Apparent Altitude.	Refract.	Apparent Altitude.	Refract.	Apparent Altitude.	Refract.
° ′	′ ″	° ′	′ ″	° ′	′ ″
4 0	11 41	4 40	10 22	5 40	8 50
1	39	41	20	42	47
2	37	42	19	44	44
3	35	43	17	46	42
4	32	44	15	48	39
5	30	45	13	50	37
6	28	46	11	52	34
7	26	47	10	54	32
8	24	48	8	56	29
9	22	49	6	58	27
10	20	50	5	6 0	24
11	18	51	3	2	22
12	16	52	1	4	20
13	14	53	0	6	17
14	12	54	9 58	8	15
15	10	55	56	10	12
16	7	56	55	12	10
17	5	57	53	14	8
18	3	58	51	16	5
19	1	59	50	18	3
20	0	5 0	48	20	1
21	10 58	2	45	22	7 59
22	56	4	42	24	56
23	54	6	39	26	54
24	52	8	36	28	52
25	50	10	32	30	50
26	48	12	29	32	48
27	46	14	26	34	46
28	44	16	23	36	44
29	42	18	21	38	42
30	40	20	18	40	40
31	38	22	15	42	38
32	37	24	12	44	36
33	35	26	9	46	34
34	33	28	6	48	32
35	31	30	3	50	30
36	29	32	0	52	28
37	27	34	8 58	54	26
38	26	36	56	56	24
39	24	38	52	58	22

TABLE II. OF REFRACTION.

Apparent Altitude.	Refract.	Apparent Altitude.	Refract.	Apparent Altitude.	Refract.
° ′	′ ″	° ′	′ ″	° ′	′ ″
7 0	7 20	9 0	5 49	13 20	3 58
3	17	3	47	30	55
6	14	6	45	40	52
9	11	9	43	50	49
12	9	12	41	14 0	46
15	6	15	40	10	43
18	3	18	38	20	40
21	1	21	36	30	38
24	6 58	24	34	40	35
27	56	27	32	50	33
30	53	30	31	15 0	31
33	51	33	30	10	28
36	48	36	28	20	26
39	46	39	26	30	24
42	43	42	25	40	21
45	41	45	23	50	19
48	38	48	22	16 0	17
51	36	51	20	15	14
54	34	54	19	30	11
57	31	57	17	45	8
8 0	29	10 0	15	17 0	5
3	27	10	11	15	3
6	25	20	6	30	0
9	23	30	1	45	2 57
12	20	40	4 56	18 0	54
15	18	50	52	15	51
18	16	11 0	47	30	49
21	14	10	43	45	47
24	12	20	40	19 0	45
27	10	30	36	15	42
30	8	40	32	30	40
33	6	50	29	45	38
36	4	12 0	25	20 0	36
39	2	10	21	15	34
42	0	20	18	30	32
45	5 58	30	15	45	30
48	56	40	11	21 0	28
51	54	50	8	15	26
54	52	13 0	4	30	24
57	50	10	1	45	22

TABLE II. OF REFRACTION.

Apparent Altitude.		Refract.		Apparent Altitude.		Refract.		Apparent Altitude.		Refract.	
°	′	′	″	°	′	′	″	°	′	′	″
22	0	2	21	39	0	1	11	58	0	0	36
	15		19		30		10	59	0		34
	30		17	40	0		8	60	0		33
	45		16		30		7	61	0		32
23	0		14	41	0		6	62	0		31
	30		11		30		5	63	0		29
24	0		8	42	0		4	64	0		28
	30		5		30		3	65	0		27
25	0		2	43	0		1	66	0		26
	30	1	59		30		0	67	0		24
26	0		57	44	0	0	59	68	0		23
	30		54		30		58	69	0		22
27	0		52	45	0		57	70	0		21
	30		50		30		56	71	0		20
28	0		48	46	0		55	72	0		19
	30		45		30		54	73	0		18
29	0		43	47	0		53	74	0		17
	30		41		30		53	75	0		15
30	0		39	48	0		52	76	0		14
	30		37		30		51	77	0		13
31	0		35	49	0		50	78	0		12
	30		34		30		49	79	0		11
32	0		32	50	0		48	80	0		10
	30		30		30		48	81	0		9
33	0		28	51	0		47	82	0		8
	30		26		30		46	83	0		7
34	0		25	52	0		45	84	0		6
	30		24		30		44	85	0		5
35	0		22	53	0		43	86	0		4
	30		20		30		43	87	0		3
36	0		19	54	0		42	88	0		2
	30		18		30		41	89	0		1
37	0		16	55	0		40				
	30		15		30		40				
38	0		13	56	0		39				
	30		12	57	0		37				

TABLE III.

Reduction of the Horizontal Parallax.

Lat.	54′	56′	58′	60′
°	″	″	″	″
6	0.2	0.2	0.2	0.2
12	1	1	1	1
18	1	1	1	2
24	2	2	3	3
30	3	3	4	4
36	5	5	5	5
42	6	7	7	7
48	8	8	8	9
54	9	10	10	10
60	11	11	11	12
66	12	12	13	13
72	13	13	14	14
78	13	14	14	15
84	14	14	15	15
90	14	15	16	16

TABLE IV. Reduction of the Horizontal Parallax.

Altitude.	Log.	Altitude.	Log.	Altitude.	Log.
° ′		° ′		° ′	
1 10	8.2271	8 0	8.2230	14 50	8.2125
20	271	10	228	15 0	121
30	271	20	226	10	118
40	270	30	224	20	115
50	270	40	222	30	111
2 0	269	50	220	40	108
10	269	9 0	218	50	104
20	268	10	216	16 0	100
30	268	20	214	10	097
40	267	30	212	20	093
50	267	40	210	30	089
3 0	266	50	208	40	086
10	265	10 0	206	50	082
20	265	10	203	17 0	078
30	264	20	201	10	074
40	263	30	199	20	070
50	262	40	196	30	066
4 0	261	50	194	40	062
10	261	11 0	191	50	058
20	260	10	189	18 0	054
30	259	20	187	10	050
40	258	30	184	20	046
50	257	40	181	30	042
5 0	255	50	179	40	037
10	254	12 0	177	50	033
20	253	10	174	19 0	029
30	252	20	171	10	024
40	251	30	168	20	020
50	250	40	165	30	016
6 0	248	50	162	40	011
10	247	13 0	159	50	006
20	245	10	156	20 0	002
30	244	20	153	10	8.1998
40	243	30	150	20	993
50	241	40	147	30	988
7 0	240	50	144	40	983
10	238	14 0	141	50	978
20	236	10	138	21 0	974
30	235	20	135	10	969
40	233	30	131	20	964
50	231	40	128	30	959

TABLE IV. Reduction of the Horizontal Parallax.

Altitude.	Log.	Altitude.	Log.	Altitude.	Log.
° ′		° ′		° ′	
21 40	81.954	28 20	8.1718	35 0	8.1406
50	949	30	711	10	397
22 0	944	40	704	20	388
10	939	50	697	30	379
20	933	29 0	690	40	370
30	928	10	683	50	361
40	923	20	676	36 0	352
50	918	30	669	10	342
23 0	912	40	662	20	333
10	907	50	655	30	324
20	902	30 0	647	40	314
30	896	10	640	50	305
40	891	20	632	37 0	296
50	885	30	625	10	286
24 0	879	40	618	20	276
10	874	50	610	30	267
20	868	31 0	603	40	257
30	862	10	595	50	247
40	857	20	587	38 0	237
50	851	30	580	10	227
25 0	845	40	572	20	218
10	839	50	564	30	207
20	833	32 0	556	40	197
30	827	10	548	50	187
40	821	20	540	39 0	177
50	815	30	532	10	167
26 0	809	40	524	20	156
10	802	50	516	30	146
20	796	33 0	508	40	136
30	790	10	500	50	125
40	784	20	491	40 0	115
50	777	30	483	10	104
27 0	771	40	475	20	093
10	764	50	466	30	083
20	758	34 0	458	40	072
30	751	10	450	50	061
40	745	20	441	41 0	050
50	738	30	432	10	039
28 0	731	40	423	20	028
10	725	50	415	30	017

TABLE IV. Reduction of the Horizontal Parallax.

Altitude.	Log.	Altitude.	Log.	Altitude.	Log.
° ′		° ′		° ′	
41 40	8.1005	48 20	8.0499	55 0	7.9858
50	8.0994	30	485	10	840
42 0	983	40	470	20	822
10	971	50	456	30	803
20	960	49 0	441	40	785
30	948	10	427	50	766
40	937	20	412	56 0	748
50	925	30	397	10	729
43 0	913	40	383	20	710
10	902	50	368	30	691
20	890	50 0	353	40	672
30	878	10	338	50	653
40	866	20	322	57 0	633
50	854	30	307	10	614
44 0	841	40	292	20	594
10	829	50	276	30	574
20	817	51 0	261	40	554
30	804	10	245	50	534
40	792	20	229	58 0	514
50	780	30	214	10	494
45 0	767	40	198	20	473
10	754	50	182	30	453
20	741	52 0	165	40	432
30	729	10	149	50	411
40	716	20	133	59 0	390
50	703	30	117	10	369
46 0	690	40	100	20	348
10	677	50	083	30	327
20	663	53 0	066	40	305
30	650	10	050	50	284
40	637	20	033	60 0	262
50	623	30	016	10	240
47 0	610	40	7.9999	20	218
10	596	50	982	30	195
20	583	54 0	964	40	173
30	567	10	947	50	150
40	554	20	929	61 0	128
50	541	30	912	10	105
48 0	527	40	894	20	082
10	513	50	876	30	059

TABLE IV. Reduction of the Horizontal Parallax.

Altitude.	Log.	Altitude.	Log.	Altitude.	Log.
° ′		° ′		° ′	
61 40	7.9035	68 20	7.7945	75 36	7.6229
50	012	30	913	48	169
62 0	7.8988	40	881	76 0	109
10	964	50	848	15	032
20	940	69 0	815	30	7.5953
30	916	10	782	45	874
40	892	20	749	77 0	793
50	867	30	715	15	710
63 0	843	40	681	30	625
10	818	50	648	45	539
20	793	70 0	613	78 0	451
30	767	10	578	15	361
40	742	20	543	30	269
50	716	30	507	45	174
64 0	690	40	471	79 0	078
10	664	50	435	20	7.4946
20	638	71 0	398	40	810
30	612	10	362	80 0	669
40	585	20	324	30	448
50	559	30	287	81 0	217
65 0	532	40	249	30	7.3969
10	504	50	211	82 0	708
20	477	72 0	172	30	429
30	449	10	125	83 0	131
40	421	20	077	30	7.2811
50	393	30	029	84 0	464
66 0	366	40	7.6981	30	088
10	337	50	931	85 0	7.1675
20	308	73 0	882	30	218
30	279	10	831	86 0	7.0708
40	250	20	780	30	129
50	220	30	728	87 0	6.9460
67 0	191	40	675	30	6.8669
10	161	50	622	88 0	6.7700
20	131	74 0	568	30	6.6451
30	100	10	514	89 0	6.4691
40	070	20	458	30	6.1680
50	039	30	402		
68 0	008	40	345		
10	7.7976	50	287		

TABLE V.

Horizon.	Parallax.	Log. Diff.	Horizon.	Parallax.	Log. Diff.	Horizon.	Parallax.	Log. Diff.
′	″		′	″		′	″	
53	0	— 0392	54	45	— 0251	56	30	— 0114
	3	0388		48	0247		33	0110
	6	0384		51	0243		36	0106
	9	0380		54	0239		39	0102
	12	0376		57	0235		42	0098
	15	0371	55	0	0231		45	0094
	18	0367		3	0227		48	0090
	21	0363		6	0223		51	0086
	24	0359		9	0219		54	0083
	27	0355		12	0215		57	0079
	30	0351		15	0211	57	0	0076
	33	0347		18	0207		3	0072
	36	0343		21	0203		6	0069
	39	0339		24	0199		9	0065
	42	0335		27	0195		12	0061
	45	0331		30	0191		15	0057
	48	0327		33	0187		18	0053
	51	0323		36	0183		21	0049
	54	0319		39	0179		24	0046
	57	0315		42	0175		27	0042
54	0	0310		45	0172		30	0038
	3	0306		48	0168		33	0034
	6	0302		51	0164		36	0030
	9	0298		54	0160		39	0027
	12	0294		57	0156		42	0023
	15	0291	56	0	0152		45	0019
	18	0287		3	0148		48	0015
	21	0283		6	0144		51	0011
	24	0279		9	0141		54	0008
	27	0275		12	0137		57	0004
	30	0270		15	0134	58	0	0000
	33	0266		18	0130		3	+ 0004
	36	0262		21	0126		6	0008
	39	0258		24	0122		9	0011
	42	0254		27	0118		12	0014

TABLE V.

Horizon.	Parallax.	Log. Diff.	Horizon.	Parallax.	Log. Diff.	Horizon.	Parallax.	Log. Diff.
′	″		′	″		′	″	
58	15	+ 0018	59	9	+ 0085	60	5	+ 0153
	18	0022		12	0089		10	0159
	21	0026		15	0092		15	0165
	24	0029		18	0096		20	0171
	27	0033		21	0099		25	0177
	30	0037		24	0103		30	0183
	33	0041		27	0107		35	0189
	36	0045		30	0111		40	0195
	39	0048		33	0115		45	0201
	42	0052		36	0118		50	0207
	45	0056		39	0122		55	0213
	48	0059		42	0126	61	0	0219
	51	0063		45	0129		5	0225
	54	0067		48	0133		10	0231
	57	0070		51	0137		15	0237
59	0	0074		54	0140		20	0243
	3	0078		57	0144		25	0249
	6	0081	60	0	0147		30	0255

TABLE VI. LOGRITHMIC SINES.

"	′ 1	′ 2	′ 3	′ 4	′ 5
0	6 4637	6 7648	6 9408	7 0658	7 1627
5	6 4985	6 7825	6 9427	7 0747	7 1699
10	6 5307	6 7995	6 9643	7 0835	7 1769
15	6 5606	6 8159	6 9756	7 0921	7 1839
20	6 5887	6 8317	6 9866	7 1005	7 1907
25	6 6150	6 8469	6 9973	7 1088	7 1975
30	6 6398	6 8617	7 0078	7 1169	7 2041
35	6 6633	6 8760	7 0180	7 1249	7 2106
40	6 6856	6 8897	7 0280	7 1327	7 2171
45	6 7068	6 9051	7 0378	7 1404	7 2234
50	6 7270	6 9160	7 0473	7 1480	7 2296
55	6 7463	6 9286	7 0566	7 1554	7 2358

"	′ 6	′ 7	′ 8	′ 9	′ 10
0	7 2419	7 3088	7 3668	7 4180	7 4637
5	7 2479	7 3140	7 3713	7 4220	7 4673
10	7 2538	7 3190	7 3758	7 4259	7 4709
15	7 2596	7 3241	7 3802	7 4299	7 4744
20	7 2654	7 3290	7 3845	7 4338	7 4780
25	7 2710	7 3339	7 3889	7 4376	7 4815
30	7 2766	7 3388	7 3931	7 4414	7 4849
35	7 2822	7 3436	7 3974	7 4452	7 4883
40	7 2876	7 3483	7 4016	7 4490	7 4918
45	7 2930	7 3530	7 4057	7 4527	7 4951
50	7 2984	7 3577	4 4099	7 4564	7 4985
55	7 3036	7 3623	7 4139	7 4601	7 5018

"	′ 11	′ 12	′ 13	′ 14	′ 15
0	7 5051	7 5429	7 5777	7 6099	7 6393
5	7 5084	7 5459	7 5804	7 6124	7 6422
10	7 5116	7 5489	7 5832	7 6150	7 6446
15	7 5149	7 5519	7 5859	7 6175	7 6470
20	7 5181	7 5548	7 5887	7 6201	7 6494
25	7 5213	7 5577	7 5914	7 6226	7 6517
30	7 5244	7 5606	7 5941	7 6251	7 6541
35	7 5276	7 5635	7 5967	7 6276	7 6564
40	7 5307	7 5664	7 5994	7 6301	7 6587
45	7 5338	7 5692	7 6020	7 6325	7 6610
50	7 5368	7 5721	7 6047	7 6350	7 6633
55	7 5399	7 5749	7 6073	7 6374	7 6656

TABLE VI. LOGARITHMIC SINES.

"	′ 16	′ 17	′ 18	′ 19	′ 20
0	7 6678	7 6942	7 7190	7 7425	7 7648
5	7 6701	7 6963	7 7210	7 7444	7 7666
10	7 6723	7 6984	7 7230	7 7463	7 7684
15	7 6746	7 7005	7 7250	7 7482	7 7701
20	7 6768	7 7026	7 7270	7 7500	7 7719
25	7 6790	7 7047	7 7289	7 7519	7 7737
30	7 6812	7 7068	7 7309	7 7538	7 7755
35	7 6834	7 7088	7 7328	7 7556	7 7772
40	7 6856	7 7108	7 7348	7 7575	7 7790
45	7 6877	7 7129	7 7367	7 7593	7 7807
50	7 6900	7 7150	7 7387	7 7611	7 7825
55	7 6920	7 7170	7 7406	7 7629	7 7842

"	′ 21	′ 22	′ 23	′ 24	′ 25
0	7 7859	7 8061	7 8255	7 8439	7 8617
5	7 7877	7 8078	7 8270	7 8454	7 8631
10	7 7896	7 8094	7 8286	7 8469	7 8645
15	7 7911	7 8111	7 8301	7 8484	7 8660
20	7 7928	7 8127	7 8317	7 8499	7 8674
25	7 7945	7 8143	7 8332	7 8514	7 8688
30	7 7962	7 8159	7 8348	7 8529	7 8703
35	7 7978	7 8175	7 8363	7 8544	7 8717
40	7 7995	7 8191	7 8379	7 8558	7 8731
45	7 8012	7 8207	7 8394	7 8573	7 8745
50	7 8028	7 8223	7 8409	7 8588	7 8759
55	7 8045	7 8239	7 8424	7 8602	7 8773

"	′ 26	′ 27	′ 28	′ 29	′ 30
0	7 8787	7 8951	7 9109	7 9261	7 9408
5	7 8801	7 8964	7 9122	7 9274	7 9420
10	7 8815	7 8978	7 9135	7 9286	7 9432
15	7 8829	7 8991	7 9147	7 9298	7 9444
20	7 8842	7 9004	7 9160	7 9311	7 9456
25	7 8856	7 9017	7 9173	7 9323	7 9468
30	7 8870	7 9031	7 9186	7 9335	7 9480
35	7 8883	7 9044	7 9198	7 9348	7 9492
40	7 8897	7 9057	7 9211	7 9359	7 9504
45	7 8910	7 9070	7 9224	7 9372	7 9516
50	7 8924	7 9083	7 9236	7 9384	7 9527
55	7 8937	7 9096	7 9249	7 9396	7 9539

TABLE VI. LOGARITHMIC SINES.

"	′ 31	′ 32	′ 33	′ 34	′ 35
0	7 9551	7 9689	7 9822	7 9952	8 0078
5	7 9562	7 9700	7 9833	7 9963	8 0088
10	7 9574	7 9711	7 9844	7 9973	8 0098
15	7 9586	7 9722	7 9855	7 9984	8 0109
20	7 9597	7 9734	7 9866	7 9994	8 0119
25	7 9609	7 9745	7 9877	8 0005	8 0129
30	7 9620	7 9756	7 9888	8 0015	8 0139
35	7 9632	7 9767	7 9898	8 0026	8 0150
40	7 9643	7 9778	7 9909	8 0036	8 0160
45	7 9655	7 9789	7 9920	8 0047	8 0170
50	7 9666	7 9800	7 9931	8 0057	8 0180
55	7 9677	7 9811	7 9941	8 0068	8 0190

"	′ 36	′ 37	′ 38	′ 39	′ 40
0	8 0200	8 0319	8 0435	8 0548	8 0658
5	8 0210	8 0329	8 0445	8 0557	8 0667
10	8 0220	8 0339	8 0454	8 0566	8 0676
15	8 0230	8 0348	8 0463	8 0576	8 0685
20	8 0240	8 0358	8 0473	8 0585	8 0694
25	8 0250	8 0368	8 0482	8 0594	8 0703
30	8 0260	8 0377	8 0491	8 0603	8 0712
35	8 0270	8 0387	8 0501	8 0612	8 0721
40	8 0280	8 0397	8 0511	8 0621	8 0730
45	8 0290	8 0406	8 0519	8 0631	8 0738
50	8 0300	8 0416	8 0529	8 0640	8 0747
55	8 0309	8 0425	8 0539	8 0649	8 0756

"	′ 41	′ 42	′ 43	′ 44	′ 45
0	8 0765	8 0870	8 0972	8 1072	8 1169
5	8 0774	8 0878	8 0980	8 1080	8 1177
10	8 0783	8 0887	8 0989	8 1088	8 1185
15	8 0791	8 0895	8 0997	8 1096	8 1193
20	8 0800	8 0904	8 1005	8 1104	8 1201
25	8 0809	8 0913	8 1014	8 1113	8 1209
30	8 0818	8 0921	8 1022	8 1121	8 1217
35	8 0826	8 0930	8 1030	8 1129	8 1225
40	8 0835	8 0938	8 1039	8 1137	8 1233
45	8 0844	8 0947	8 1047	8 1145	8 1241
50	8 0852	8 0955	8 1055	8 1153	8 1249
55	8 0862	8 0963	8 1063	8 1161	8 1257

TABLE VI. LOGARITHMIC SINES.

′ ″	′ 46	′ 47	′ 48	′ 49	′ 50
0	8 1265	8 1358	8 1450	8 1539	8 1627
5	8 1273	8 1366	8 1457	8 1546	8 1634
10	8 1280	8 1373	8 1465	8 1554	8 1641
15	8 1288	8 1381	8 1472	8 1561	8 1648
20	8 1296	8 1388	8 1480	8 1569	8 1656
25	8 1304	8 1396	8 1487	8 1576	8 1663
30	8 1311	8 1404	8 1495	8 1583	8 1670
35	8 1319	8 1412	8 1502	8 1590	8 1677
40	8 1327	8 1419	8 1509	8 1598	8 1684
45	8 1335	8 1427	8 1517	8 1605	8 1691
50	8 1343	8 1434	8 1524	8 1612	8 1699
55	8 1350	8 1442	8 1532	8 1620	8 1706
″	′ 51	′ 52	′ 53	′ 54	′ 55
0	8 1713	8 1797	8 1880	8 1961	8 2041
5	8 1720	8 1804	8 1887	8 1968	8 2047
10	8 1727	8 1811	8 1893	8 1974	8 2054
15	8 1734	8 1818	8 1900	8 1981	8 2060
20	8 1741	8 1825	8 1907	8 1988	8 2067
25	8 1748	8 1832	8 1914	8 1994	8 2073
30	8 1755	8 1839	8 1920	8 2001	8 2080
35	8 1762	8 1846	8 1927	8 2007	8 2087
40	8 1769	8 1852	8 1934	8 2014	8 2093
45	8 1776	8 1859	8 1940	8 2021	8 2100
50	8 1783	8 1866	8 1948	8 2028	8 2106
55	8 1790	8 1873	8 1954	8 2034	8 2112
″	′ 56	′ 57	′ 58	′ 59	′ 60
0	8 2119	8 2196	8 2271	8 2346	8 2419
5	8 2125	8 2202	8 2278	8 2352	8 2425
10	8 2132	8 2208	8 2284	8 2358	8 2431
15	8 2138	8 2215	8 2290	8 2364	8 2437
20	8 2145	8 2221	8 2296	8 2370	8 2443
25	8 2151	8 2227	8 2302	8 2376	8 2449
30	8 2158	8 2234	8 2309	8 2382	8 2455
35	8 2164	8 2240	8 2315	8 2388	8 2461
40	8 2170	8 2246	8 2321	8 2394	8 2467
45	8 2177	8 2253	8 2327	8 2400	8 2473
50	8 2183	8 2259	8 2333	8 2406	8 2479
55	8 2189	8 2265	8 2339	8 2413	8 2485

TABLE VII.

Moon's Altitude.	Augmentation of ☽'s Semidiameter.
°	″
0	0
5	1
10	3
15	4
20	6
25	7
30	8
35	9
40	10
45	11
50	12
55	13
60	14
70	15
80	16
90	16

PROBLEM I.

FROM the latitude and longitude by account, the hour of obſervation by the meridian of the place of obſervation, and the Moon's obſerved altitude to find her true altitude by the tables.

RULE I.

WRITE down your obſerved altitude, and under it the dip, for the number of feet above the ſurface taken from Tab. I. with the ſign —, and correct it by ſubtraction.

II. WITH the corrected altitude take out the refraction from Tab. II. with the ſign —, and correct a ſecond time by ſubtraction.

III. TURN the longitude by account into time, and if it is eaſt ſubtract it from the given time, the difference will be the time at Greenwich; but if it is weſt, it muſt be added to the given time.

IV. WITH this corrected time, take out the Moon's horizontal parallax from the ephemeris.

V. WITH the given latitude and horizontal parallax enter Tab. III. and take out the correction, which muſt always be ſubtracted from the horizontal parallax given in the ephemeris.

VI. WITH the altitude corrected for dip. and refraction enter Tab. IV. and take out the logarithm; and with the horizontal parallax corrected enter Tab. V. and take out the logarithm with its ſign, if the ſign is + the two logs muſt be added; but if it is leſs or — it muſt be ſubtracted.

VII. WITH

PROBLEM I.

VII. WITH the ſum or difference of the two logarithms enter Tab. VI. of ſigns, and take out the minutes and ſeconds correſponding thereto and place it under the altitude laſt corrected, and add; the ſum is the altitude of the Moon's lower limb three times corrected.

VIII. WITH the time uſed in the 4th Rule, take out the Moon's ſemi-diameter from the ephemeris, alſo her augmentation from Tab. VII. and add it to the true altitude of the lower limb, the ſum is the true altitude of the Moon's centre.

PROBLEM II.

From the latitude of the place, the longitude by account, the moon's obſerved altitude, and the time by the meridian of the place of obſervation, to find the true longitude.

RULES.

1ſt. Find the true altitude of the moon's center by problem 1ſt.

2d. With the time uſed in rule the fourth of problem 1ſt. take out the moon's declination correctly from the ephemeries.

3d. Take the complement of the latitude, the complement of the altitude, and the moon's diſtance from the pole, add them together and take half their ſum; from the half ſum ſubtract the co. altitude, and call it remainder.

4th. Take the complement arithmetical of the co. ſine of the latitude, the complement arithmetical of the ſine

of

of the moon's diſtance from the pole, the log. ſine of half the ſum, and the log. ſine of the remainder, add theſe four logarithms together, half the ſum is the co. ſine of half the moon's diſtance in right aſcenſion from the meridian; double it and call it the horary angle.

5th. Take the ſun's right aſcenſion from the ephemeris in time for the laſt noon at the place of obſervation, and thereto add the apparent time of obſervation, together with the ſun's motion in that time; turn the ſum into degrees and minutes by multiplying by 15, and it will be the right aſcenſion of the mid-heaven.

6th. If the moon is not come to the meridian, add the horary angle to the right aſcenſion of the mid-heaven, but if it is paſt the meridian, let them be ſubtracted; the ſum, or difference, will be the moon's right aſcenſion at the place of obſervation.

7th. Seek in the ephemeris in the column of right aſcenſions of the moon for the given day, and write out the two neareſt, whether at noon or midnight, or at midnight and noon; take the difference of the firſt and ſecond, alſo the difference of the firſt and the moon's right aſcenſion above found—then ſay,

As the firſt remainder is to 12 hours,
So is the ſecond remainder to the true Greenwich time.

8th. The difference of the time of obſervation, and true Greenwich time, is the difference of longitude in time, which multiplied by 15, is the true longitude either weſt or eaſt; if the Greenwich time is greateſt, the longitude is weſt, if leſs it is eaſt.

OBSER-

OBSERVATION I.

1784, March 5. In latitude 51° 29′ N. longitude 35″ of time W. the altitude of the moon's lower limb by reflection from water horizon covered with glass roof, was observed 36° 46′ 45″ at 8h 18′ 50″ apparent time. Required the true longitude?

h ′ ″			° ′ ″
8 18 50	apparent time		36 46 45
23 7 4	☉s AR at noon.	A true horⁿ dip,	0 0
+1 22	☉'s motion	Tab. II. Refraction	—1 17
	HP=54′ 41″		
7 27 16	Tab. III.—8	8.1310 Tab. IV.	=36 45 28
☽5			
	54 33	Tab V—0266	
☽05			
6 49 0		8.1044 Tab. VI.	= +43 43
111 49 0	AR Mid. Ceil		37 29 11
	° ′	Semidiameter	+14 54
Declⁿ noon	=13 29 N	Augmentⁿ Tab. VII.	+10
midnight	=10 51 N		
		True Altitude ☽'s center	37 44 15
12h	2 38		
		Z.D	=52 15 45
6 =	1 19	0.009058 . P.D	=78 20 36
2 =	0 26 20	0.205692 . Co.L	=38 31 0
18′ =	3 57		
1′ 25″=35″+50″=	19		169 7 21
	1 49 36	9.998039 . ½ sum	84 33 40
	11 39 24 N	9.727798 . Rem.	32 17 55
P.D	=78 20 36	19.940587	
			° ′ ″
		9.970294 = Cos.	20 57 5
		horary ∠	=41 54 10
		AR. mid. ceil.	= 111 49 0
	D M		
Right Ascenⁿ noon	=149 52	. . ☽s AR.	=153 43 10
Midnt	=155 26	. .	149 52 0
	5 34		3 51 10

h ′ ″		
	2 47	0=6h
8 18 50 apptⁿ time	55 40	=2
8 18 20 Greenʰ time	8 21	=0 18
	9	=0 0 20
0 0 30 E		
0 0 35 W	3 51 10	=8 18 20 Greenʰ time
1 5 Error=12 miles.		

OBSERVATION II.

Dec. 20, 1790. By J. P. Esq. Lat. 51° 30′ 48″ long. 34″ W.

h	′	″					
7	31	12	apparent time				
17	55	13	☉'s AR at noon.				
+	1	14	☉'s motion				
1	27	39					
15							
21	54	45	AR Mid. Ceil.				

HP = 55′ 8″
— 10
54 58 Tab V — .0231

8.1483 Tab. IV. = 33 30 20

8.1252 Tab. VI. = + 45 52

	°	′
Decl^n noon =	19	5 N.
	19	12
		7 in 12 hours.
	3	30 = 6^h
	0	53 = 1 30′
	4	23
	19	9 23
P. D. =	70	50 37

	° ′ ″
☽'s L. L.	33 29 15
Observation Error	+ 2 30
	33 31 45
	— 1 25
	34 16 12
Semid. & Aug.	+ 15 12
	34 31 24
Z. D. =	55 28 36
0.024740 . P. D. =	70 50 37
0.205977 . Co. L. =	38 29 12
	164 48 25
9.996172 . ½ sum =	82 24 13
9.655959 . Rem^r =	26 55 37
19.882848	
9.941424 Cos.	29 5 38
	58 11 16 AM
	21 54 45
	80 6 1
° ′ ″	75 58 0
Diff. Na. Alm. 6 31	. . 4 8 1
3 15 30	. . 6
32 35	. . 1
19 33	. . 0 36
25	. . 0 0 45
4 8 3	. . 7 36 45
	7 31 12
	5 33 W.
Longitude	— 34 W.
Error 55 miles. =	4 59

OBSERVATION III.

Jan. 9, 1791. By J. P. Esq.

h ′ ″			° ′ ″
6 23 49	apparent time	☽'s L.L.	29 2 55
19 23 33	⊙ AR	Observation Error	+2 30
+ 1 3			
	55′ 38″=HP.		29 5 25
1 48 25	−9		−1 42
15			
		8.1687 Tab. IV.	=29 3 43
	55 29 Tab. V.	−0192	
27 6 15	AR Mid. Ceil		
		8.1495 Tab. VI.	= 48 30
			29 52 13
Decl^n noon	1 30 S	Semid. & Aug^n	+ 15 17
Midnight	0 32 N		
	2 2 in 12 hours	True Alt.	30 7 30
	1 1 0=6 hours	Z.D.	=59 52 30
	0 4 4=24′	0.000011 . . P.D.	=90 24 56
		0.205977 . . Co.L.	=38 29 12
	1 5 4		
			188 46 38
	0 24 56S		
		9.998725 . . ½ Sum	94 23 19
P.D.	90 24 56		
		9.753278 . . Rem.	34 30 49
		19.957991	
		9.978996 Cos.	17 40 35
			2
			35 21 10 P.M.
			27 6 15
			351 45 5
			348 38 0
Diff. from Na. Alm.		5 52 . .	3 7 5
		2 56 . .	6
		11 44	0 24
		3 7 44	6 24
		−44	−1 30
		+5	+10
		3 7 5 =	6 22 40 G^h time.
			6 23 49
			−1 9E
			+34W long.
			Error 1 43=19 miles.

OBSERVATION IV.

☉ *June* 5, 1791. At Union Obſervatory by wire in the teleſcope for a horizon adjuſted by Spirt Level.

h. ′ ″

12 47 40 ☽ LL } per tranſit clock 30″ faſt for ſiderial time.
12 51 17 ☽ UL }

				° ′ ″
12 49 29	Center			22 13 30
— 30	HP.=55′ 24″		Tab. II.	— 2 19
	Tab.III.— 9			
12 48 59		8.1938	Tab.IV.=	22 11 11
15	55 15	Tab.V.–.0211		
192 14 45	AR Mid. Ceil.	8.1727	Tab. VI.	+ 51 10
12 48 59	AR. Mid. Ceil.		☽'s true Altitude	23 2 21
4 53 25	—☉'s AR at noon.		Z.D.=	66 57 39
7 55 34		0.015944 .	P.D.=	74 34 10
— 1 18	☉'s motion.	0.205493 .	Co.L.=	38 32 16
7 54 16	apparent time.			180 4 5
+ 21	W. long.			
		10 .	½ ſum	90 2 3
7 54 37	Greenwich time			
		9.593192 .	Rem.	23 4 24

Declination
Noon. =16 10N
Midnt 15 3
1 7

		19 814629		
				° ′ ″
		9.907315	Coſ.	36 7 0
				2
6 h. .	0 33 30			72 14 0 P.M.
2 . .	0 11 10			192 14 45
—6′	— 33			
+ 36	+ 3	☽'sAR noon	115 52	120 0 45 ☽'sAR.
		Midnight.	122 10	115 52 0
	0 44 10		6 18	4 8 45
	15 25 50			
P.D.=74 34 10			3 9 0 =	6 0 0
			1 3 0 =	2 0 0
			— 3 9 =	– 6 0
			— 6 =	– 0 12
			4 8 45 =	7 53 48 G^h time.
				7 54 16 app^t time.
				28E
				21W

Error 10 miles.=49

OBSERVATION V.

☉ *June* 5, 1791. Repeated.

h. ′ ″				° ′ ″
12 53 31	☽'s L.L.			
12 56 50	☽'s U.L.			
12 55 10	= Center	. . . .		21 21 15
— 30			Tab. II.	— 2 25
12 54 40		8.1965 .	Tab. IV. =	21 18 50
15		—0211		
193 40 0	AR. Mid. Ceil.	8.1754	Tab. VI. =	+51 28
12 54 40				22 10 18
—4 53 25				
			Z.D =	67 49 42
8 1 15	0.015923	. . .	P.D. =	74 34 40
—1 19	0.205493	. .	Co.L. =	38 32 16
7 59 56	appt T.			180 56 38
	9.999986	. .	½ sum	90 28 19
	9.585458		remains	22 38 37
	19.806860		° ′ ″	
	9.903430	Cos.	36 48 36	
			73 37 12	
			193 40 0	
	° ′			
	122 10	. .	120 2 48	
	115 52	. .	115 52 0	
	6 18	. .	4 10 48	
			h. ′ ″	
	3 9	. .	6 0 0	
	1 3	. .	2 0 0	
	— 1 3	.	— 2 0	
	— 9	.	— 17	
	4 10 48	. .	7 57 43	Greenwh time.
			7 59 56	apparent time.
			2 13	E.
			21	W.

Error 2 34 = 28 miles.

OBSERVATION VI.

June 9, 1791. At Union Obſervatory, by reflection from glaſs, brought horizontal by Spirit Level.

h. ′ ″				° ′ ″
12 41 42	☽'s LL	. . . . .		72 29 30
12 48 55	☽'s UL			36 14 45
12 45 19	Center	HP=58.5	Tab. II.	— 1 19
— 29	clock faſt.	— 9	8.1339 Tab. IV.=	36 13 26
12 44 50		57 56	—1005	
5 9 55			8.1334 Tab. VI.	+ 46 44
7 34 55				37 0 10
— 1 15				
7 33 40	apparent time.		Z.D.=	52 59 50
		0.000156	P.D.=	88 28 19
12 44 50		0.205493	CoL.=	38 32 16
15				180 0 25
191 12 30	AR Mid. Ceil.			
		10	½ ſum	90 0 12
Declination.				
Noon.=2 53N		9.779524	Rem.	37 0 22
Midnt 0 44N				
2 9		19.985173		
		9.992586	Coſ. 10 33 25	
6 h. . 1 4 30				
1 30 . 16 7			21 6 50	
4 . 42			191 12 30	
1 21 19		166 3 .	170 5 40	
		172 26 .	166 3 0	
1 31 41				
P.D=88 28 19		6 23 .	4 2 40	

	h. ′ ″	
3 11 30	= 6 0 0	
31 55	= 1 0 0	
15 58	= 0 30 0	
3 11	= 0 6 0	
6	= 0 0 12	
4 2 40	= 7 36 12	Greenwich time.
	7 33 40	apparent time.
	2 32	W longitude.
	21	W

Error 2.11=24 miles.

OBSERVATION VII.

June 9. Repeated.

h. ′ ″			° ′ ″
13 4 45 ☽ LL			
13 11 5 ☽ UL			
13 7 55	Center	?	68 56 0
— 29			
			34 28 0
13 7 26		Tab. II.	— 1 25
5 9 45			
	8.1436	Tab. IV. =	34 26 35
7 57 41	—0005		
— 1 18			
	8.1431	Tab. VI.	+ 47 48
7 56 23 app^t time.			
+ 21 W			35 14 23
7 56 44 Greenw^h time.		Z.D =	54 45 37
	0.000140	P.D. =	88 32 21
	0.205493	Co.L. =	38 32 16
			181 50 14
	9.999944	½ sum	90 55 7
	9.770866	Rem.	36 9 30
	19.976443		
	9.988222 Cos.	° ′ ″ 13 16 58	
13 7 26			
15		2	
		26 33 56	
196 51 30		196 51 30	
	166 3	170 17 34	
	172 26	166 3 0	
	6 23	4 14 34	
		h. ′ ″	
	3 11 30 =	6 0 0	
	1 3 50 =	2 0 0	
	4 15 20 =	8 0 0	
	— 32 =	— 1 0	
	— 16 =	— 0 30	
	+ 2 =	+ 4	
	4 14 34 =	7 58 34	Greenwich time.
		7 56 23	apparent time.
		2 11	W longitude.
		— 21	W
		Error 1 50 = 20 miles.	

FINIS.

☞ The preceding obſervation was inſerted in a former edition of this little work, with ſome trifling inſtances of error; but as it has by ſome perſons been ſuggeſted that the method would not admit of ſufficient accuracy, it is here reprinted with the neceſſary corrections, and the author has the ſatisfaction to find that the reſult ſtill falls much within the limits allowed to obſervations of this nature.———The following obſervations have alſo been made, to aſcertain the degree of accuracy to which the method may be depended on, and the author appeals to thoſe gentlemen accuſtomed to make lunar obſervations, whether they can practiſe them with nicer preciſion?